

# HARDENING PROTECTION COMPOSITIONS FOR PARTIAL CARBURIZATION OF METALLIC COMPONENTS

## INTRODUCTION AND BACKGROUND

The present invention relates to hardening protection  
5 compositions for partial carburization of metallic  
components.

In the heat treatment process for surface hardening of  
metals, it is often necessary for components to be partly  
protected before the treatment process, such as  
10 carburization, nitrocarburization or nitriding, in order  
still to be able to carry out certain mechanical working  
steps later on in selected surface areas, or in order to be  
able to retain the original properties of the material, such  
as, for example, the ductility.

15 In addition to electroplating with copper or nickel, for a  
long time there has already been a wide range of lacquer-like  
protective compositions which are applied to the selected  
surface areas before carrying out the hardening treatment. In  
the case of partial carburization, protective composition  
20 based on water-glass or based on substances which form boron  
glass have proved themselves useful for protection against  
diffusing-in of carbon.

While the compositions based on water-glass can be purged  
only mechanically after the hardening operation by blasting  
25 the components with sand or glass beads etc., protective  
compositions based on substances which form boron glass have  
the great advantage of being able to be washed off with  
water. However, with the known hardening protection  
compositions based on substances which form boron glass,  
30 there is the risk of running off in the oven during the  
hardening operation, in particular after incomplete drying or

due to binding of moisture from the atmosphere by the composition, since the viscosity of the boron components is greatly reduced by water at a high temperature.

- Furthermore, at carburization temperatures of 900-980 °C the boron compound can vaporize until vapour pressure equilibrium is established. On the one hand this results in a decrease in the protective action due to the protective layer becoming thinner, and on the other hand an oven lining of SiO<sub>2</sub>-containing bricks can also be attacked. In particular, because of the relatively high vapour pressure such compositions can be employed to only a limited extent in reduced pressure carburization, since damage to the reduced pressure carburization plant by vaporizing boron compounds must be expected.
- The protective compositions based on water-glass hitherto employed as an alternative in vacuum carburization plants tend to become brittle and flake off during high-pressure gas quenching. The treatment plants then become contaminated. The heat exchangers can thus become covered with particles, or the fan bearing can be damaged, which can lead to a plant shut-down.

Therefore, an object of the present invention was to discover and develop hardening protection compositions for partial carburization of metallic components which do not have the disadvantages of the known products.

#### SUMMARY OF THE INVENTION

The above and other objects of the present invention can be achieved by addition of magnesium-silicon compounds to hardening protection compositions which are otherwise composed in a known manner and are based on substances which

form boron glass. An advantage of the present invention is that the risk of running off of substance and the vapour pressure can be reduced drastically.

The present invention therefore provides hardening protection  
5 compositions based on substances which form boron glass for partial carburization of metallic components, which are characterized in that they comprise magnesium-silicon compounds as an additive.

By the addition according to the invention of magnesium-  
10 silicon compounds, an increased reliability against incorrectly isolated areas due to the protective composition running off is achieved in gas carburization.

An increased life of the oven lining is furthermore achieved, and the use of protective compositions based on substances  
15 which form boron glass in vacuum carburization is rendered possible.

All inorganic magnesium-silicon compounds are in principle suitable as the additive according to the invention for the hardening protection compositions based on substances which  
20 form boron glass. Typical compounds which are suitable for this use are magnesium silicates, such as, for example, magnesium orthosilicate ( $\text{Mg}_2\text{SiO}_4$ ), magnesium metasilicate ( $\text{MgSiO}_3$ ), magnesium trisilicate ( $\text{Mg}_2\text{Si}_3\text{O}_8$ ) and talc. Magnesium trisilicate is particularly preferred.

## 25 DETAILED EMBODIMENTS OF THE INVENTION

The hardening protection compositions according to the invention typically comprise substances which form boron glass and magnesium-silicon compounds in a weight ratio of 2:1 to 100:1. A weight ratio of substances which form boron

glass to magnesium-silicon compounds of 5:1 to 15:1 is preferred, in particular approximately 10:1.

The hardening protection compositions according to the invention comprise boric acid, boron oxide, alkali metal  
5 and/or alkaline earth metal borates as substances which form boron glass.

The hardening protection compositions of this invention comprise three essential main components; (a) the active ingredient or active ingredient system, (b) an organic binder  
10 system that enables the coating of the surface to be protected through application, dipping or spraying, and (c) auxilliary agents that assist and help in imposing the handling and treatment during preparation, as well as improving storage characteristics. Organic binder systems  
15 that can be used according to the invention are film forming organic polymers which are soluble in organic solvents or dispersible in water. Preferred binder systems are based on acrylic resins dissolved in xylol or butylacetate.

The hardening protection compositions according to the invention can comprise, based on the total amount, 35-70 wt.%  
20 of an organic binder system and can be formulated in a liquid, semi-liquid or paste-like consistency. Suitable binder systems are known per se and familiar to the expert, and correspond to those such as are used in hardening  
25 protection compositions which have been employed hitherto in practice.

Typical hardening protection compositions according to the invention comprise, for example, 40-55 wt.% boron oxide, 3-6  
30 wt.% magnesium trisilicate and 39-57 wt.% of an organic binder system, in each case based on the total amount.



carburized at 930°C for 5 h to a chd of 1.2 mm, quenched in oil and cleaned in an industrial washing machine.

Result of the treatment:

There were several runs which are to be attributed to flow of the protective composition during the treatment. The hardness was mostly 32-36 HRC in the covered area, 49-55 HRC in the area of the runs, 61-63 HRC in the unprotected area outside the runs. The isolation was defective, and the component was therefore unusable.

10 Example 3 (according to the invention):

A protective composition of 50 wt.% boron oxide, 5 wt.% magnesium trisilicate and 45 wt.% of an organic binder system was applied to a component at room temperature and dried for 10 hours at room temperature. Thereafter, the component was carburized in a reduced pressure carburization plant to a chd of 0.6 mm, quenched in a cold chamber and cleaned in an industrial washing machine.

Result of the treatment:

Exactly the area to be isolated was protected, and there was no running at all of the protective composition. The protective composition did not flake off during the quenching. The hardness was 31-33 HRC in the covered area, 61-63 HRC in the unprotected area. The isolation was defect-free. The component could be cleaned without problems in the industrial washing machine.

Example 4 (comparison example):

A protective composition of 55 wt.% boron oxide, and 45 wt.% of an organic binder system was applied to a component at room temperature and dried for 10 hours at room temperature.

Thereafter, the component was carburized in a reduced pressure carburization plant to a chd of 0.6 mm, quenched in a cold chamber and cleaned in an industrial washing machine.

Result of the treatment:

5 There were several runs which are to be attributed to flow of the protective composition during the treatment. The hardness was mostly 31-34 HRC in the covered area, 47-54 HRC in the area of the runs, 61-63 HRC in the unprotected area outside the runs. The isolation was defective, and the component was  
10 therefore unusable.

Example 5 (comparison example):

A protective composition based on water-glass was applied to a component at room temperature and dried for 10 hours at room temperature. Thereafter, the component was carburized in  
15 a reduced pressure carburization plant to a chd of 0.6 mm, quenched in a cold chamber and cleaned in an industrial washing machine.

Result of the treatment:

There were no runs, and the hardness was 29-32 HRC in the  
20 covered area, 61-63 HRC in the unprotected area. Partial flaking off of the protective composition of about 20% of the composition applied was to be found during the quenching. The residues of the protective composition which had flaked off were hard and could be removed from the quenching chamber, in  
25 particular from the heat exchangers, only with a very great outlay. As a result of these particles remaining in the plant, a shortening of the running time of the plant and a deterioration in functioning are to be expected. The residues of the protective composition could not be washed off in the

industrial washing machine. It was possible to clean the component only by blasting with sand or glass beads.

Further variations and modifications of the foregoing will be apparent to those skilled in the art and are intended to be  
5 encompassed by the claims appended hereto.

German priority application 100 38 447.1 is relied on and incorporated herein by reference.

100 38 447.1